UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 8
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SEP - 8 2014

Ref: 8P-W-UIC

Mr. Kevin Frederick
Wyoming Department of
Environmental Quality (WDEQ)
Water Quality Division
Herschler Building
122 West 25th Street
Cheyenne, Wyoming 82002

Re: Linc Energy Ltd Class III Aquifer Exemption Request Underground Coal Gasification Demonstration Gasifier #6 Project Wyodak Coals - Fort Union Formation Campbell County, Wyoming

Dear Mr. Frederick:

The U.S. Environmental Protection Agency Region 8 has reviewed your aquifer exemption (AE) request/program revision package, received July 7, 2014. This request, initially and informally received on August 29, 2013, is for the proposed Wyoming Department of Environmental Quality (WDEQ) designation of a limited portion of the Wyodak coals in the Fort Union Formation, Campbell County, Wyoming, as an exempted aquifer.

This request is in connection with the Class III Underground Coal Gasification (UCG) Demonstration Gasifier #6 Project proposed by Linc Energy Ltd (Linc) to inject ambient air/oxygen for UCG mining activities.

APPROVAL OF PROPOSED AQUIFER EXEMPTION: Based on review of the supporting information provided by the WDEQ, and pursuant to 40 CFR §144.7(b)(3), the EPA hereby approves a non-substantial program revision (see 40 CFR §§144.7 & 145.32) to include exemption of a portion of the Wyodak coals in the Fort Union Formation. The aquifer exemption area is depicted in Attachment 1 (Figure 13.14-1) of the Record of Decision. The depth and extent of the aquifer exemption is as follows:

> The Wyodak coals of the Fort Union Formation are located at an approximate depth of 1,100 feet below ground surface and are approximately 27 to 30 feet thick. This area is generally horizontally described by the excursion monitor well ring plus a distance approximately 144 feet beyond the monitor well ring as shown in the Record of Decision, Attachment 1 (Figure 13.14-1).

Based on our review of the information provided, the EPA is approving the aquifer exemption using the regulatory criteria listed below:

- this portion of the aquifer does not currently serve as a source of drinking water (40 CFR §146.4(a)), and
- this portion of the aquifer cannot now and will not in the future serve as a source of drinking water because it is mineral producing and can be demonstrated to contain minerals that, considering their quantity and location, are expected to be commercially producible (40 CFR §146.4(b)(1)).

The EPA's approval is limited to this 80-acre pilot project at this location and the injection activities described herein. Additional approvals by the EPA may be required for additional injection activities at this project site. Enclosed please find the Record of Decision, which provides the rationale supporting our decision. The EPA maintains its discretion to approve or disapprove future AE requests, including for pilot or commercial scale coal gasification projects in the Powder River Basin. The EPA's determination that the 40 CFR §146.4 criteria are met in this case should not be construed as binding on or indicative of the EPA's future AE decisions because future AEs must be determined based on their specific facts. The EPA maintains discretion to disapprove an AE request, even when the 40 CFR §146.4 criteria are met.

Should you have questions or concerns, please contact me at (303) 312-6434, or have your staff contact Wendy Cheung at (303) 312-6242.

Sincerely,

Callie A. Videtich
Acting Assistant Regional Administrator
Office of Partnerships and Regulatory Assistance

Enclosure: Record of Decision

cc: Nancy Nuttbrock, LQD
Don Fischer, LQD
Robert Smith, OGWDW

U.S. EPA Region 8
Underground Injection Control Program

AQUIFER EXEMPTION RECORD OF DECISION

This Record of Decision provides the EPA's aquifer exemption (AE) decision, background information concerning the AE request, and the basis for the AE decision.

Primacy Agency: Wyoming Department of Environmental Quality (WDEQ) 1422 Program

Date of Aquifer Exemption Request: July 7, 2014

Substantial or Non-Substantial Program Revision: Non-Substantial

Although the EPA must approve all revisions to the EPA-approved state Underground Injection Control (UIC) programs, the process differs depending on whether the EPA treats the revision as a substantial or non-substantial program revision. The EPA treated this as a non-substantial program revision because it is associated with the issuance of a site-specific Class III UIC permit action, not a state-wide programmatic change or a revision with implications for the national UIC program. The decision to treat this as a non-substantial program revision is also consistent with the EPA's "Groundwater for Review and Approval of State Underground Injection Control (UIC) Programs and Revisions to Approved State Programs" (Guidance 34) and a past AE request related to Underground Coal Gasification (UCG) Research and Development (R&D) in Wyoming. The EPA's Guidance 34, explains that the determination as to whether a program revision is substantial or non-substantial is made on a case-by-case basis, and with the exception of AEs associated with certain Class I wells or exemptions not related to action on a permit, AE requests are typically treated as non-substantial program revisions.

Operator: Linc Energy Ltd. (Linc)

Well/Project Name: Underground Coal Gasification (UCG) Demonstration Gasifier #6 Project

Well/Project Permit Number: Linc Energy R&D License TFN 5 5/128

Well/Project Location: NW ¼ Section 36 of Township 44N, Range 74W

County: Campbell **State**: WY

Well Class /Type: Class III UCG

DESCRIPTION OF PROPOSED AQUIFER EXEMPTION

Aquifer to be Exempted: A portion of the Wyodak coal, Tongue River Member of the Fort Union Formation

Water Quality – Total Dissolved Solids (TDS) (mg/L): 560 mg/L

Depth and Thickness of Aquifer (feet): The depth to the top of the Wyodak coal is approximately 1,100 feet below ground surface. The thickness of the Wyodak coal varies between 27 and 30 feet at this site. The exempted portion of the Wyodak coal includes this entire vertical interval and is confined above and below by low permeability claystone and shale. The Overburden and the Underburden are not included in this AE.

Areal Extent of Aquifer: The areal extent of the exemption is approximately 80 acres. Linc has provided a GIS shape file that delineates the AE boundary and submitted Figure 13.14-1 (Attachment 1) with the AE application.

Confining Zone(s): The Wyodak coal is overlain and underlain by low permeability claystone and shale of the Fort Union Formation. In the vicinity of the project, the thicknesses for the Overburden and Underburden are 24 to 30 and 10 feet, respectively. These overlying and underlying confining claystone and shale layers are continuous across the exemption area.

Injectate Characteristics: Ambient air/oxygen is delivered to the coals through injection wells to recover syngas.

Regulatory Criteria for AE Request: The WDEQ has proposed exemption under the criteria at 40 CFR § 146.4(a) and (b)(1). WDEQ determined that the area proposed for exemption is not currently a source of drinking water and cannot now and will not in the future be a source of drinking water because it is mineral, hydrocarbon, or geothermal energy producing, or can be demonstrated by a permit applicant as part of a permit application for a Class II or III operation to contain minerals or hydrocarbons that, considering their quantity and location, are expected to be commercially producible.

The area proposed for exemption is approximately 80 acres in the northwest part of Linc's lease (see Attachment 1, Figure 13.14-1) for the permitted research and development project.

The exempted area was determined based on the location of the excursion wells (EWs) plus a calculated distance beyond the EW perimeter. Based on experience gained at the Rocky Mountain I UCG demonstration project, the EWs are placed at the recommended minimum distance of 600 feet from the cavities to account for the "gasifier area of influence," a gasifier operations zone of elevated product gas concentration and pressure that commonly extends into the coal surrounding the gasifier cavity. Additionally, the fractured nature of coals provides a preferred pathway for gas migration and further supports the need for a large separation between the gasifier cavity and EWs. The calculated distance beyond the EW perimeter to the AE boundary is similar to methodology that has been adopted by uranium in-situ recovery operators in Wyoming applying for Class III permits. That distance was calculated to be 144 feet. Should an excursion be detected at an EW, this additional distance will allow Linc to detect and begin operational controls to bring the excursion under control before it reaches an adjacent USDW. The distance of the AE boundary is calculated to be approximately 744 feet from the gasifier.

The record indicates that commenters expressed concern that the AE boundary is not extensive enough to prevent contaminants from endangering USDWs. Similarly, concerns were raised regarding the derivation of the 144 feet from the EW perimeter to the AE boundary. The values that Linc used to calculate the AE boundary were conservative. First, Linc assumed an absence of inward hydraulic gradient towards the gasifier that will be maintained during gasification and restoration. In fact, there will be an inward hydraulic gradient during operation and restoration. Second, the travel time was calculated assuming a conservative substance that is not retarded as it moves with the groundwater. The contaminant of greatest concern are the hydrocarbons which will rapidly retard in the coal environment and will no longer be mobile. Therefore, both of these assumptions make the AE boundary calculation a conservative estimate and the AE area is appropriately sized for this UCG project.

BACKGROUND

Linc, an Australia-based company, has applied for a Class III UIC permit with the WDEQ to target the Wyodak coal in the Fort Union Formation for the purposes of recovering syngas through the UCG process. Ambient air/oxygen will be injected into the subsurface through an injection well to create a high temperature and pressure subsurface environment to gasify the coals into syngas which is extracted in a paired production well.

The WDEQ AE request dated August 29, 2013 proposed exemption of portions of the Fort Union Formation to support Linc's Class III UCG permit. The EPA provided an interim response dated October 25, 2013, stating that the EPA was unable to provide a decision until the EPA had opportunity to review all comments and WDEQ's response to comments. During the public comment period, WDEQ received a number of comments. At the request of the Powder River Basin Resource Council (PRBRC), a contested case hearing was held before the Environmental Quality Council (EQC). The PRBRC, WDEQ, and Linc participated. The EQC issued an order on January 9, 2014, approving the mining license. Based on concerns from commenters, the WDEQ decided to have another public hearing on March 26, 2014 to accept additional oral and written comments. On July 7, 2014, WDEQ submitted a final package to the EPA with the comments received and the State's response to comments.

Linc holds a 640 acre coal lease located in Section 36 of Township 44N, Range 74W in Campbell County, Wyoming. At the urging of WDEQ, Linc submitted a Class III application that would target a smaller portion of the leased area to provide additional assurance of the viability of the technology and demonstrate that the process can be carried out without endangering USDWs, which resulted in the UCG Demonstration Gasifier #6 Project (project). The lateral distance from the injection well to the production well is approximately 2700 feet (see Attachment 2, Figure 14-5 Production Zone and Predicted Cavity Size). The gasifier will operate 90 to 120 days to create up to five discrete cavities along the injection well. The final dimension of each cavity for the demonstration will be approximately 11.5 feet high, 24 feet wide, and 66 feet long at maturity. A 52 foot long pillar separates each cavity.

BASIS FOR DECISION

Underground Source of Drinking Water (USDW)

The Wyodak coal within the Fort Union aquifer is a USDW at this project site. The TDS of water samples from the Wyodak coals ranged from 380 to 1,310 mg/L within the Linc leased area and averaged 560 mg/L in the vicinity of the project. Due to previous coal bed methane (CBM) operations, the coals have been dewatered such that it currently yields approximately 1.2 gal/min. The water quality and its yield qualify the Wyodak coals as a USDW and requires an AE to inject under a Class III permit.

Regulatory Criteria under which the exemption is approved

40 CFR § 146.4(a) *It does not currently serve as a source of drinking water*

Linc conducted a survey of the Wyoming State Engineer's Office (SEO) water rights database to determine groundwater use in the vicinity of the project. Based on this research, the nearest private domestic drinking water well to the proposed exemption area is approximately 1.5 miles to the west of the AE boundary. The SEO database does not provide the aquifer from which the water is withdrawn, but indicates that it is located at a depth of 175 feet. The completion report from two CBM wells ¼ mile

due east and due west of this domestic well show that the Big George coal (which is above the Wyodak coal) is over 800 feet below ground surface at both locations. This well is located above the Big George coal. Therefore, this well does not and will not draw water from the exempted portion of the Wyodak coal. Also, it is separated from the Wyodak coal by hundreds of feet of stratigraphy, including the Big George coal and low permeability claystone and shale.

The closest private domestic drinking water well deep enough to potentially use the Wyodak coal as a source of drinking water is six miles to the northeast of the AE boundary and located at a depth of 1,001 feet. To determine if this well has the potential to draw from the approximately 80 acre AE area at the Linc site, the EPA performed a capture zone analysis using a calculated fixed radius equation as described in the EPA's *Ground Water and Wellhead Protection Handbook* (EPA/625/R-94/001 report). In performing the calculations, the following assumptions were made: 1) the drinking water well is constantly pumping; 2) a porosity of 0.02 determined at the Linc site is also representative of the Wyodak coal in this region, including the domestic drinking water well located six miles away; 3) a conservative value of 25 gpm pumping rate (maximum value allowed by the SEO for a private well); 4) life of the well ranges from 50 to 100 years; and 5) length of the well screen (the portion of the well which draws groundwater) ranges from 10 to 30 feet. Using the ranges stated above, the conservative results indicate that the well could withdraw groundwater from as far as 1.3 to 3.2 miles away. Because the Linc site is 6 miles away, the approximately 80 acre portion of the Wyodak coal proposed for exemption is not a current source of drinking water for the well.

The nearest municipal wells that utilize the Fort Union are six wells owned by the Town of Wright which is approximately 10 miles to the east of the project. The *Wright Groundwater Supply Project Level III, Drilling and Testing of RJ-4 Well, Operating Plan and Preconstruction Report* (Jan 1986) and *Wright Water & Sewer District Water Supply Level II Well No. RJ-7, Final Report* (Dec, 2012) were reviewed. The reports indicate that these six municipal wells draw from the sandstones in the Lebo and Tullock members of the Fort Union Formation and are screened 1,200 feet below ground surface or deeper. Review of completion reports for Wyodak CBM wells, obtained from the Wyoming Oil and Gas Conservation Commission website, shows that in this area the base of the Wyodak coal is 1,100 feet or shallower. Therefore, there is over 100 feet of confining mudstone, claystone, and shale between the Wyodak coal and the uppermost screen for these wells, and the Wyodak coal is not used as a source of drinking water.

There are no water wells (domestic, irrigation, stock, or industrial) located within the proposed AE boundary. Because there are no drinking water wells that would draw from the portion of the Wyodak coal proposed for exemption, the EPA has determined that it does not currently serve as a source of drinking water.

The record indicates that some commenters were concerned about the presence of livestock watering wells nearby. There are livestock watering wells located outside of the AE boundary. However, the presence of livestock wells was not relevant to the EPA's evaluation of whether this aquifer is currently serving as a source of human drinking water and whether it meets the demonstration required by 40 CFR § 146.4(b)(1). The purpose of the Safe Drinking Water Act in general and the UIC program specifically is to provide water that is safe for human consumption.

40 CFR § 146.4(b)(1)

It cannot now and will not in the future serve as a source of drinking water because:

It is mineral, hydrocarbon, or geothermal energy producing, or can be demonstrated by a permit

applicant as part of a permit application for a Class II or III operation to contain minerals or hydrocarbons that considering their quantity and location are expected to be commercially producible.

The WDEQ provided information to the EPA to support its conclusion that this portion of the Wyodak coal within the Fort Union aquifer cannot now and will not in the future serve as a source of drinking water because it is part of a permit application for a Class III operation that contains minerals in a quantity and location that is expected to be commercially producible.

For Class III wells, 40 CFR § 144.7(c)(1) requires the applicant that "necessitates an aquifer exemption under 40 CFR §146.4(b)(1), to furnish the data necessary to demonstrate that the aquifer is expected to be mineral or hydrocarbon producing. Information contained in the mining plan for the proposed project, such as a map and general description of the mining zone, general information on the mineralogy and geochemistry of the mining zone, analysis of the amenability of the mining zone to the proposed mining method, and a time-table of planned development of the mining zone" shall be considered by the Director.

In its request, the WDEQ provided information demonstrating that there are minerals that are expected to be commercially producible. The depth to the top of the Wyodak coal ranges from 1,075 to 1,230 feet and is generally 24 to 30 feet thick within the permit area, except in the northeast portion where it is about 12 feet thick. Linc's lease includes the entire Section 36 of Township 44N, Range 74W, or 640 acres. During the 90 to 120 days when the gasifier operates, approximately 11 to 16.8 tons of coal per day will be mined producing approximately 1 million standard cubic feet per day (MMscfd) of syngas. The record indicates that commenters were concerned that coal was not the mineral being mined, and therefore, the application could not meet the criteria. Although it is not brought to the surface in its solid form, the coal is processed in-situ and the syngas is recovered at the surface. In other words, the processing of the resource occurs underground.

Chemical analysis of cores of the Wyodak coal seam collected at the site found that the coal composition is conducive to the UCG technology. The Wyodak coal mainly consists of B-rank sub-bituminous coal, with intervals of A and C-rank coal. The averaged total gas content values through the Wyodak coal were reported at 11.2 standard cubic feet (scf) per ton of coal.

While the current permit is a R&D project and therefore smaller in scale, the lease held by Linc at this location is expected to contain quantities that are commercially producible. We note that the record indicates commenters are concerned that this AE request does not meet the criteria because the company plans to vent the syngas produced. However, the criterion does not require that the permittee actually commercially produce a product, but only demonstrate that there are minerals or hydrocarbons that *are expected to be commercially producible.* Although the R&D permit is a short term (90 to120 day) gasification project affecting less than one surface acre of the coal, a substantial quantity of coal exists in the section that Linc has leased that can be expected to be commercially producible. Therefore, the EPA finds that WDEQ has demonstrated that Wyodak coal is identified in a permit application for a Class III operation as containing minerals, which considering their quantity and location, are expected to be commercially producible.

After consideration of the record, including the public comments, the EPA finds that WDEQ's submission meets the criteria for exemption at 40 CFR § 146.4. Therefore, the EPA is authorized to approve the AE. The EPA has discretion to disapprove the AE even if it meets the regulatory criteria for

exemption, but the EPA has chosen not to exercise that discretion here because this is a small pilot project and the permit is protective of adjacent USDWs. If Wyoming submits a subsequent AE request for a larger portion of the aquifer, the EPA may consider a number of factors, including the quality of the water (e.g., TDS), in evaluating whether to exercise its discretion to disapprove the exemption even if the regulatory criteria are met.

Ensuring Protection of Adjacent USDWs

Subsidence Modeling and Monitoring

The cavity size and length of the pillars between each cavity to support the overburden were determined to minimize the potential for subsidence of the overlying claystone and shale. Based on the geomechanical subsidence modeling provided by Agapito Associates, Inc., the maximum subsidence predicted by the numerical model is about 0.0006 ft. Additionally, Linc will be required to have in place surface and subsurface monitoring as part of the permit condition:

Surface monitoring: An array consisting of 25 surface subsidence monuments will be installed above where the cavities will occur. Baseline elevations will be established prior to ignition, monitored monthly during operation, and annually for the remaining period of the permit.

Subsurface monitoring: A total of three (3) Time Domain Reflectometry (TDR) boreholes will be located on the centerline of where the cavities will occur. Each borehole will house the TDR cables and changes to their readout (voltage pulses) will provide indication of subsurface deformation of the overburden. The TDR cables will be grouted in open boreholes drilled to an approximate depth of five (5) feet above the top of the Wyodak coal.

The Agapito model demonstrates the risk for subsidence is low. Linc additionally has in place a robust monitoring network to detect small changes in ground movement to minimize impacts and prevent large subsidence events from occurring.

Additional exemptions of the overlying or underlying aquifers are not necessary since the overburden is not expected to be compromised and due to the inward fluid gradient, contaminants are expected to remain within the exemption area during operation and restoration.

Hydrogeology and Engineering Controls

The site specific hydrogeologic setting and engineering controls at this project provide assurance that fluids will remain within the proposed exempted area. The low permeable Overburden and Underburden claystone and shale provide the geological confinement above and below the Wyodak coals. In the vicinity of the project, the thicknesses for the Overburden and Underburden are 24 to 30 feet and 10 feet, respectively. These overlying and underlying confining claystone and shale layers are continuous across the exemption area.

Previously at this site, CBM production from the Wyodak lowered the potentiometric surface and groundwater levels in the Wyodak are now slowly recovering at an average rate of 0.2 ft/day. Potentiometric levels within the Wyodak in the vicinity of the gasifier cavities are about 320 feet lower than the underlying Underburden aquifer and about 80 feet lower than the overlying Overburden aquifer. This creates a setting where the Wyodak coals have a lower pressure than the overlying and underlying

aquifers, thereby creating a preferential inward flow toward the targeted coals and away from the AE boundary.

Throughout the operation and restoration process, the potentiometric head and groundwater flow volume will be carefully controlled through pumping and injection of groundwater within the Wyodak coals, and the Overburden and Underburden aquifers. One of the research and development objectives of the project is to refine techniques and procedures in order to:

- Maintain vertical and horizontal groundwater flow potential toward the gasifier throughout operations and restoration,
- Control the pressure differential between the Wyodak and adjacent aquifers, and
- Control groundwater impingement rates to the gasifier.

In addition to the hydraulic containment favored by the existing hydrogeology at the site and Linc's planned operational controls, a robust monitoring plan will also be required to demonstrate the fluids remain within the exempted area. There are two sets of concentric monitoring well rings with the AE boundary found exterior to both (see Attachment 1, Figure 13.14-1 of the application).

The first set of monitoring wells, approximately 200 to 250 feet from the injection and production well pair, consists of 20 trend wells fairly regularly spaced in the Wyodak coals, and the Underburden and Overburden aquifers. These monitoring wells serve as early warning should unexpected hydraulic conditions be detected at the site. A second set of 17 EWs will be placed exterior to the trend wells. Nine of these form a second ring outside of the gasification region to monitor groundwater conditions in the Wyodak coals. These are located approximately 250 to 400 feet outside of the trend well, but located interior to the AE boundary. The remaining eight are Underburden and Overburden aquifer monitoring wells downgradient and northwest of the project. Each trend and EW will be equipped with a dedicated submersible pump for sampling. These wells will continuously monitor groundwater temperature, pressure and conductivity which will provide early detection should a loss of hydraulic control occur. If the data shows unexpected results, selected wells in the impacted area will be sampled for four Upper Control Limits (UCLs): phenol, benzene, ammonia, and conductivity, to determine if an excursion has occurred. A commenter was concerned that excursion monitoring would not be broad enough to detect excursions. However, these four UCLs are representative of the organic and inorganic contaminants that may be produced during the UCG process. If an excursion is detected, engineering controls will be set in motion to prevent migration of any contaminants outside of the exempted area.

Several commenters expressed concerns regarding the aquifer heterogeneity, the preferential flow in the Wyodak coal, and the impact these may have on contaminant transport. Linc's literature studies show that the Powder River Basin is heterogeneous across its 20,000 square miles. When the focus is narrowed to this specific site there is less heterogeneity, and Linc relied on site specific data gathered from their pump tests, log analysis, and sampling data to provide information that would be most appropriate for their models. Even within its 640-acre lease boundary, Linc recognizes the variability at its site and as a commenter pointed out, the variability in the thickness of the coals in the northeast part of the lease is 12 feet. However, in the approximately 80 acres in which the AE is proposed, well logs show that the Wyodak coal is between 27 and 30 feet thick. Furthermore, a seismic profile conducted just within the proposed area for gasification shows the Wyodak continuous and horizontal.

Linc's hydrogeological study in the permit area does demonstrate there is preferential groundwater flow. Because coal is relatively impervious, fluids in this formation will follow the fractures. The field

investigations broadly support the conclusion that the most likely direction of maximum principal transmissivity in the Wyodak coal is along a north-northeast to south-southwest oriented axis. As a result, Linc sited their trend and EWs to maximize detection of an excursion, in recognition of preferential groundwater flow paths.

Commenters also expressed concern regarding leakage through the upper and lower confining layers. Linc's application discussed hydraulic communication between Wyodak through the adjacent aquitards. An aquitard, is a low permeable layer which restricts flow but does not completely retard flow. At this site there is a naturally existing hydraulic gradient inward toward the gasifier which will be continually monitored and controlled. Unless an external force is applied, such as through a pump test or through an existing fracture, flow through aquitards is not expected to occur away from the Wyodak coals due to the higher hydrostatic pressure in the Overburden and Underburden aquifers. The vertical hydraulic conductivity for the Underburden was calculated to be 2 e-7 ft/day and the Overburden is even smaller. The fact that there remains distinctly higher pressures in the Overburden and Underburden aquifers provides empirical evidence that a seal exists. Additionally, the seismic profile conducted just within the proposed area for gasification shows the Wyodak with no major fractures or faults present.

The EPA acknowledges that heterogeneity, preferential groundwater flow, and leakage has been identified by Linc. However, the inward hydraulic flow maintained during gasification and restoration, Linc's planned engineering controls required by its permit, and the monitoring plan described below, demonstrate that the surrounding USDWs will be protected.

Monitoring and Restoration

The geochemistry of the Wyodak coal has also been extensively analyzed to provide baseline values for restoration. The parameters to be monitored include constituents that are native to the Wyodak coal as well as hydrocarbons that are produced during the gasification process. These include phenolic compounds, BTEX, PAHs, and inorganics such as metals, and major and minor ions.

Linc is required by their Class III permit to restore the groundwater back to baseline or WDEQ class of use parameters if best practicable technology has been demonstrated. The by-products generated by the UCG process are of two types: organic and mineral. At the conclusion of the mining operations, Linc will analyze the groundwater in the cavity and in the neighboring monitoring wells for:

- Organic compounds such as found in tar, char and oils generated during the combustion of coal and in particular the pyrolysis phase. These include:
    - Phenolic compounds: phenol, cresols, dimethylphenols;
    - BTEX: benzene, toluene, ethylbenzene, xylenes; and
    - PAHs': naphthalene, 3- and 4- rings aromatics, indanes.
- Inorganic compounds from ash generated in the cavity and from the altered overburden, such as:
    - Major ions: Ca, Mg, Na, K, SO_4, Cl;
    - Minor ions: Ba, B, Ra, Si, Sr, U;
    - Metals: Al, As, Be, Cd, Co, Cr, Cu, Fe, Hg, Mo, Mn, Ni, Pb, Se, V, Zn; and
    - Ammonia, cyanide, thiocyanate.

Linc estimates up to six pore volumes will be required to flush the mining zone, but restoration efforts will continue until post-restoration parameters are met. Following restoration, a minimum of six months of stabilization monitoring is required to evaluate the efficacy of the restoration process. Although UIC Federal regulations do not require restoration of the exempted aquifer, the proposed restoration plan will

provide assurance that contaminants remain within the exemption boundary.

Other Considerations

Commenters provided the EPA a document dated April 19, 2013 entitled "Notice Requiring Relevant Information." This is an Australian Department of Environment and Heritage Protection (DEHP) document which details its concerns of potential groundwater contamination and its attempt to discover the origin. In the document, the DEHP required Linc to disclose monitoring data that had not been previously made available to them to help determine the origin of the contamination. The EPA reviewed this document and determined that it did not provide any additional specific information that should be factored into the review of this WDEQ AE request. The EPA reviews AEs on a case-by- case basis because the success of each project is site specific and strongly dependent upon the local geology. We do not have information indicating that the geology is the same as that found at the Linc site. Furthermore, the technology Linc is using at its Wyoming site differs from that at its Australia operation. The operational plan and design of Gasifier #6 is based on lessons learned in their Australian Gasifier #4 and #5 projects. Given this, it is not possible for the EPA to draw any conclusions from this information that would assist us in reviewing this AE.

Similarly, commenters cite concerns about the UCG process because of problems at historic sites such as Hoe Creek. However, because review of aquifer exemptions is on a site-specific case-by-case basis, we are unable to draw any conclusions from these projects that would assist in our review of the current project.

A commenter also expressed concerns regarding uncontrolled coal seam fires that are occurring across the country and elsewhere globally. The conditions at the Linc site do not allow for uncontrolled coal seam fires to occur. Uncontrolled coal seam fires can only be sustained when oxygen is readily available. At the depth of this Linc project, there is an absence of oxygen, unless it is purposely delivered which is part of the operation plan for the Linc project. Furthermore, the Wyodak coal is a water bearing aquifer, unlike the situations where uncontrolled coal seam fires occur. Once groundwater is encountered, these coal fires would cease. Based on these findings, the EPA has concluded that there is minimal risk of uncontrolled coal seam fires resulting from this UCG pilot project.

There were a number of other comments on the record that raised the following concerns: the method to obtain samples could lead to variable results; the bonding and financial responsibility may not be adequate; whether monitoring results would be made public; whether cementing in the well construction would be adequate; and whether there is a need for additional protocol if an excursion is detected. WDEQ has primary enforcement authority and is responsible for issuing the UIC permit and implementing and enforcing the approved UIC program. These issues are outside the scope of the AE decision. While the EPA did review the permit in the context of our analysis to determine whether the fluids will remain within the AE area, the EPA is not the permitting authority and therefore, the comments listed above were outside the scope of our review.

CONCLUSION AND DECISION

Based on review of the entire record, the EPA finds that exemption criteria 40 CFR § 146.4(a) and 146.4(b)(1) have been met and the EPA approves the AE request as a non-substantial program revision.

In making this decision, the EPA considered all the information submitted by the State, including all the written and oral comments submitted to the State during its public comment processes. Additionally, the EPA considered written comments submitted directly to the EPA even though these were submitted outside the public comment processes made available by the WDEQ. We acknowledge that a commenter alleges flaws in the WDEQ's public process and therefore requested that the EPA hold its own public comment period. However, the regulations do not require the EPA to provide an additional opportunity for public comment for a non-substantial program revision, and we determined that an additional public comment period would not likely yield additional comments that have not already been raised in this case. The WDEQ did provide an opportunity for public comment and hearing, consistent with the EPA's regulation at 40 CFR § 144.7. While commenters expressed concern that the second public hearing occurred after the EQC issued an Order of approval, the WDEQ affirmed its recommendation after the conclusion of the public hearing process. The EPA reviewed the information and comments de novo, or anew, and therefore had the full benefit of reviewing all written and oral public comments prior to making a decision.

There were a number of factors in this case leading the EPA to the conclusion that USDWs would be adequately protected and that it is not necessary to use our discretion to disapprove this AE. In this case, the project is limited to an approximately 80-acre area for a research and development project. The proposed gasification process is of limited duration, as it will only operate 90 to 120 days. Furthermore, the EPA finds that in this case, the hydraulic containment afforded by the existing hydrogeology at the site, Linc's planned engineering controls required by its permit, and a robust monitoring plan will protect the surrounding USDWs.

The EPA's approval is limited to this approximately 80-acre pilot project and the EPA maintains its discretion to disapprove future AE requests, including for pilot or commercial scale coal gasification projects in this basin. See 46 Fed. Reg. 48243, 48245 Oct. 1, 1981; 47 Fed. Reg. 4992, 4993 (Feb. 3, 1982) and 49 Fed. Reg. 20138, 20141-142, and 20143 (May 11, 1984). See also, Memorandum from Peter Grevatt, the EPA Office of Ground Water and Drinking Water to the EPA Water Division Directors, "Enhancing Coordination and Communication with States on Review and Approval of Aquifer Exemption Requests under SDWA". Therefore, a determination that the regulatory criteria for exemptions are met in this case should not be construed as binding on or indicative of the EPA's future AE decisions because future exemption requests will be evaluated based on their specific facts. The EPA has the discretion to disapprove a project, even when the regulatory criteria are met.

Attachment 1

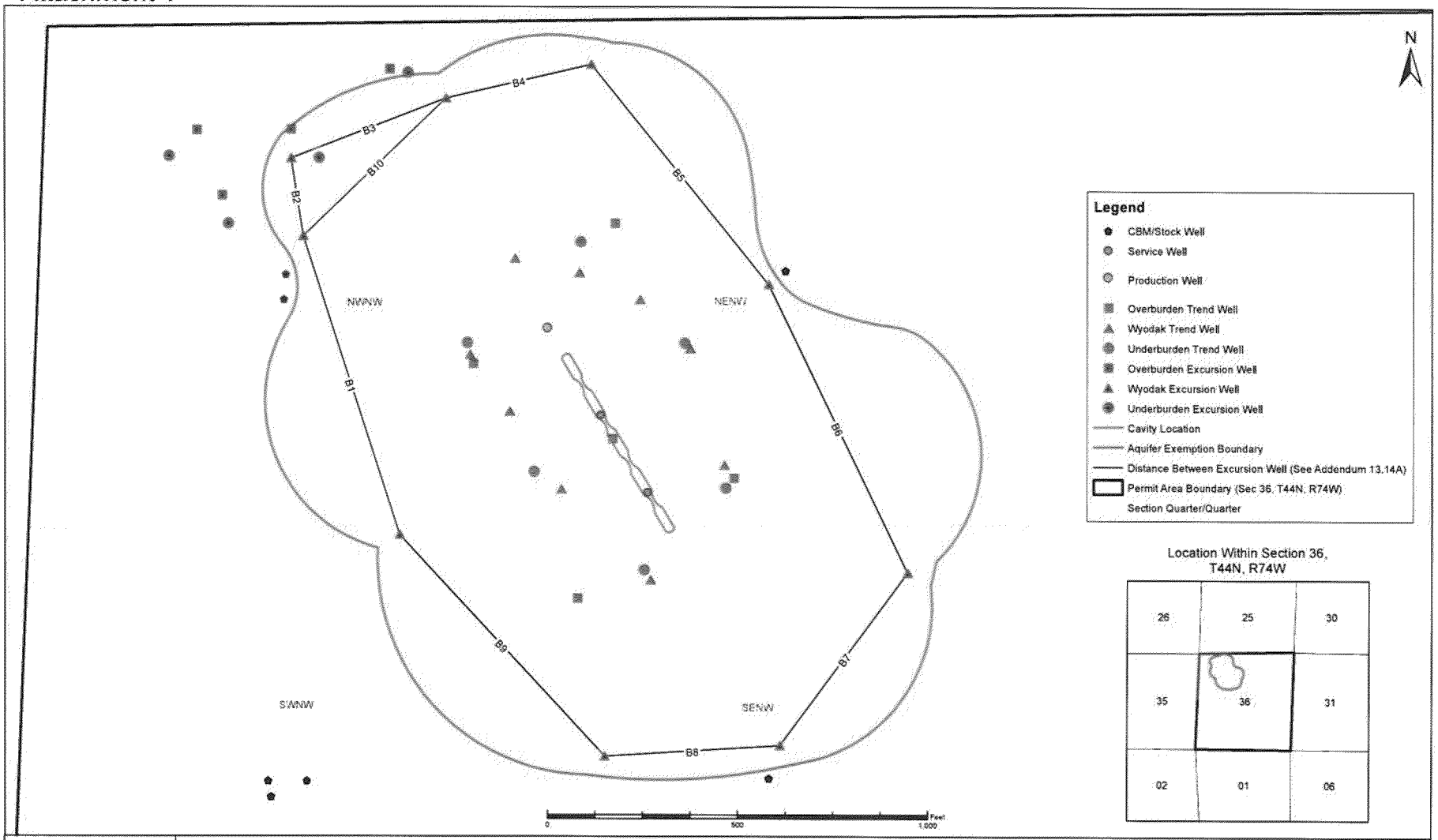

FIGURE 13.14-1: PROPOSED AQUIFER EXEMPTION AREA WITHIN NW 1/4, SEC 36,T44N,R74W

Campbell County,Wyoming	Path: X:\UCG_Data\364474\Aquifer_Exemption_Figure_13.14-1 WDEQ.mxd	1 inch = 250 feet	Coordinate System: NAD 1983 UTM Zone 13N	Drawn By: N.K Date: 06 AUG 2013

Attachment 2

Figure 14-5 Production Zone and Predicted Cavity Size